## 4.4 NEVADA TEST SITE

NTS is located on approximately 365,100 hectares (880,000 acres) in southern Nye County, Nevada. The site is located 105 kilometers (65 miles) to the northwest of Las Vegas and 16 kilometers (10 miles) northeast of the California State line (see **Figure 4–22**). All of the land within NTS is owned by the Federal Government and is administered, managed, and controlled by DOE's NNSA. NTS contains approximately 900 buildings that provide approximately 259,300 square meters (2,790,600 square feet) of space. Many of these facilities have been either mothballed or abandoned because of the reduction of program activities at the site (DOE 1998b).

NTS (originally the Nevada Proving Grounds) was established in 1950 as an on-continent proving ground and has seen more than four decades of nuclear weapons testing. Since the nuclear weapons testing moratorium in 1992 and under the direction of DOE, test site use has diversified into many other programs. Programs currently conducted at NTS include those related to defense, waste management, environmental restoration, nondefense research and development, and work for others (DOE 1996e).

The Device Assembly Facility (DAF) is located in Area 6, which is situated within the east-central portion of NTS. This area occupies about 21,200 hectares (52,500 acres) between Yucca Flat and Frenchman Flat, straddling Frenchman Mountain. The area was used for one atmospheric and five underground nuclear tests between 1957 and mid-1990 (DOE 1996e). Unless otherwise referenced, the following descriptions of the affected environment at NTS and DAF are based all or in part on information provided in the *NTS SWEIS* (DOE 1996e), which is incorporated by reference.

### 4.4.1 Land Resources

#### 4.4.1.1 Land Use

Federal lands surround NTS, with the Nellis Air Force Range Complex located on the north, east, and west, and U.S. Bureau of Land Management lands on the south and southwest. Beyond the Federal lands surrounding NTS, principal land uses in Nye County in the vicinity of the site include mining, grazing, agriculture, and recreation. Of the total land area within the county, only a small number of isolated areas are under private ownership and, therefore, are subject to general planning guidelines. Rural communities located within the vicinity of NTS include Alamo, 69 kilometers (43 miles) to the northeast; Pahrump, 42 kilometers (26 miles) to the south; Beatty, 26 kilometers (16 miles) to the west; and Amargosa Valley, 5 kilometers (3 miles) to the south.

Clark County, Nevada, lies immediately to the east of NTS. The Federal Government owns 95 percent of the county. Primary land uses on these Federal lands include open grazing, mining, and recreation. Outdoor recreational areas located in the vicinity of NTS include Lake Mead National Recreation Area, 121 kilometers (75 miles) to the east; Red Rock National Conservation Area, 64 kilometers (40 miles) to the southwest; Death Valley National Monument, 19 kilometers (12 miles) to the west-southwest; and Desert National Wildlife Range, 5 kilometers (3 miles) to the east. Several state parks are also located within 80 kilometers (50 miles) of NTS.

Land use zone categories at NTS include the Nuclear Test Zone, Nuclear and High Explosives Test Zone, Research Test and Experiment Zone, Radioactive Waste Management Zone, Solar Enterprise Zone, Defense Industrial Zone, and Reserved Zone (**Figure 4–23**). In most cases, an area is assigned to a use category based on the environmental characteristics it exhibits. Environmental characteristics, especially geography and geology, generally determine how suitable an area is for a particular use. Technical and experimental areas cluster in those sectors of NTS where geography and geology are most favorable to testing (DOE 1998b).

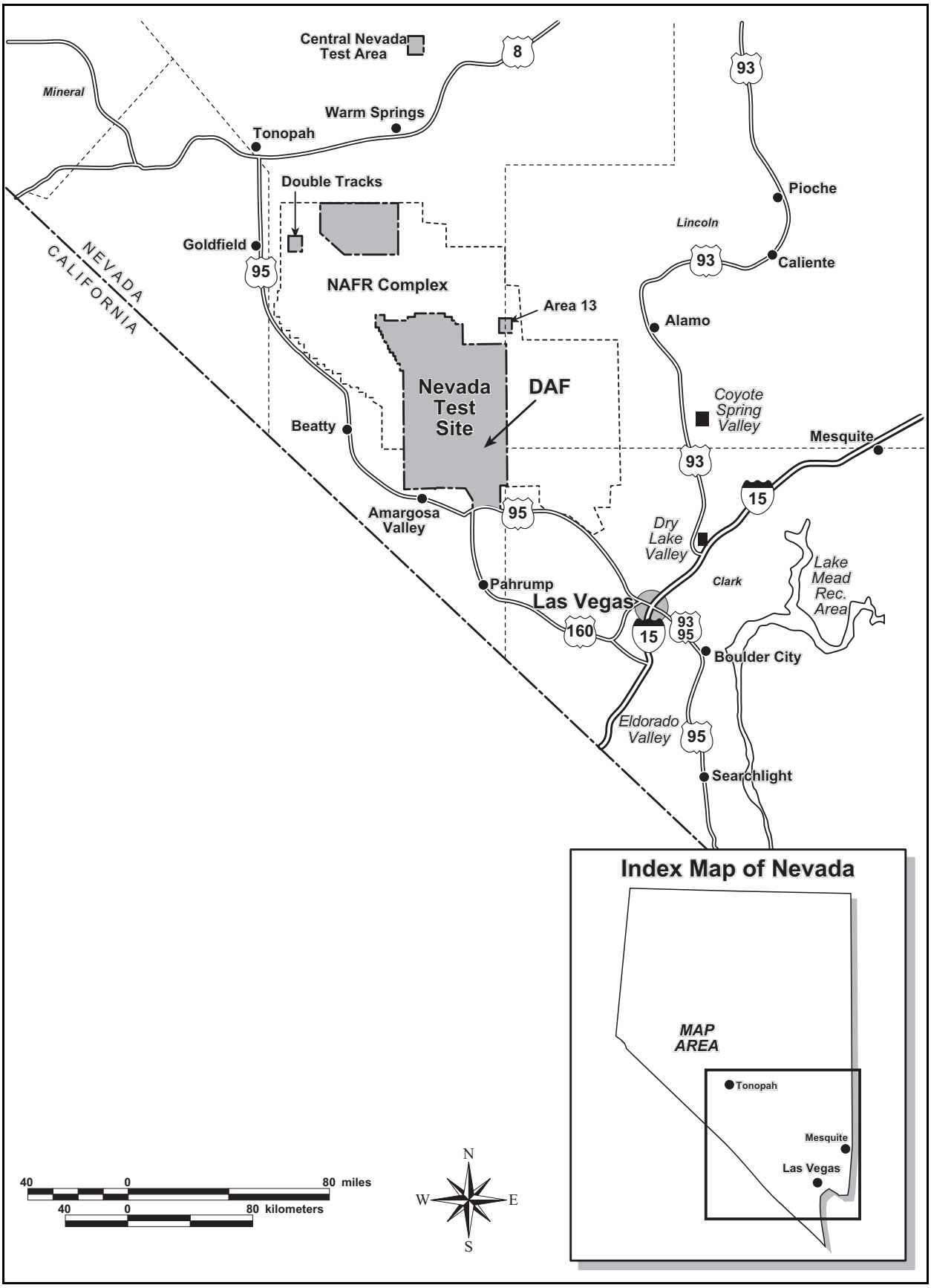


**Figure 4–22 Location of NTS**

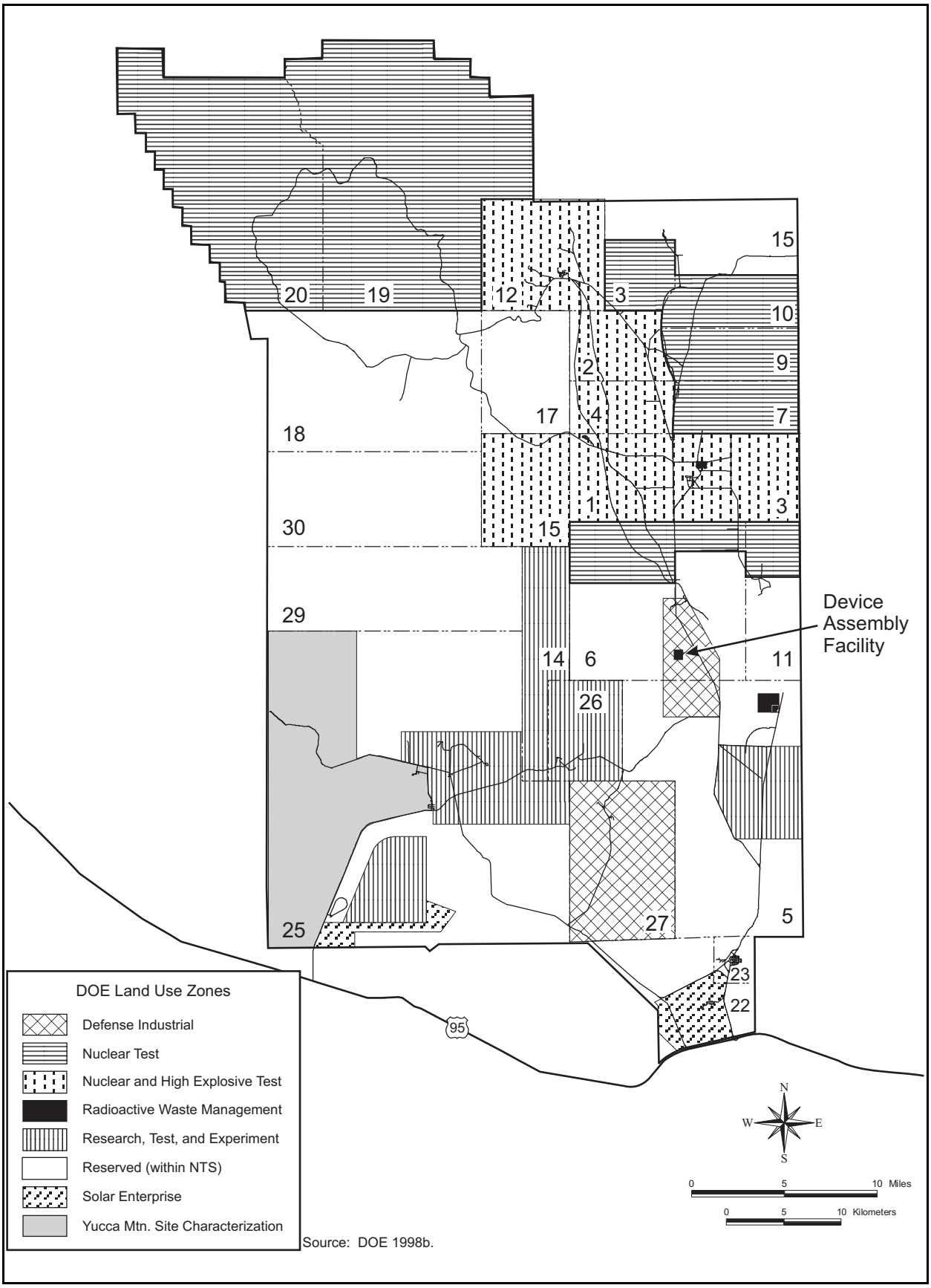


**Figure 4–23 Land Use at the Nevada Test Site**

Approximately 45 percent of NTS is currently unused or provides buffer zones for ongoing programs or projects, while about 7 to 10 percent (24,300-35,000 hectares [60,000-86,500 acres]) of the site has been disturbed. The following information describes the land use zones.

**Nuclear Test Zone**—This area is reserved for dynamic experiments, hydrodynamic tests, and underground nuclear weapons and weapons effects tests. This zone includes compatible defense and nondefense research, development, and testing activities.

**Nuclear and High Explosives Test Zone**—This area is designated within the Nuclear Test Zone for additional underground nuclear weapons tests and outdoor high explosive tests. This zone includes compatible defense and nondefense research, development, and testing activities.

**Research Test and Experiment Zone**—This area is designated for small-scale research and development projects and demonstrations; pilot projects; outdoor tests; and experiments related to the development, quality assurance, or reliability of material and equipment under controlled conditions. This zone includes compatible defense and nondefense research, development, and testing projects and activities.

**Radioactive Waste Management Zone—**This area is designated for the management of radioactive wastes.

**Solar Enterprise Zone—**The area is designated for the development of a solar power generation facility, as well as light industrial equipment and commercial manufacturing capabilities.

**Defense Industrial Zone—**This area is designated for stockpile management of weapons, including production, assembly, disassembly or modification, staging, repair, retrofit, and surveillance. Also included in this zone are permanent facilities for stockpile stewardship operations involving equipment and activities such as radiography, lasers, material processing, and pulsed power.

**Reserved Zone—**This area includes land and facilities that provide widespread flexible support for diverse short-term testing and experimentation. The reserved zone is also used for short-duration exercises and training such as nuclear emergency response and Federal Radiological Monitoring and Assessment Center training and Department of Defense (DoD) land-navigation exercises and training.

NTS is part of the National Environmental Research Park network, although certain areas of the site are excluded from this designation because of operations or other activities related to the primary mission of the site. The National Environmental Research Park designation provides for research into biological diversity, plant and community development in disturbed and undisturbed landscapes, regional climate trends, soil formation differences, and other factors that control environmental conditions. Additionally, the compatibility of the environment with energy technology options can be studied (DOE 1998b).

Land-use planning does not occur at the state level in Nevada; however, counties and other municipalities may plan if they so choose. The recently adopted Nye County comprehensive plan is a policy document that permits the county to begin a process of establishing a comprehensive land-use plan and zoning ordinance. No municipalities within Nye County have adopted land-use plans, policies, or controls (DOE 1996g).

Three land use zones occur in Area 6 (Figure 4–23). The northern quarter of the area is designated as the Nuclear Test Zone, the south central portion is categorized as the Defense Industrial Zone, and the remaining area is designated as the Reserved Zone. DAF, which occupies 12 hectares (29 acres) of land, is located within the Defense Industrial Zone (DOE 1995d). The facility is isolated from other structures and is surrounded by desert (Figure 3–9).

#### 4.4.1.2 Visual Resources

NTS is located in a transition area between the Mojave Desert and the Great Basin. Vegetation characteristic of both deserts is found on the site. The topography of the site consists of a series of north-south-oriented mountain ranges separated by broad, low-lying valleys and flats. Site topography is also characterized by the presence of numerous subsidence craters resulting from past nuclear testing. The southwestern Nevada volcanic field, which includes portions of NTS, is a nested, multicaldera volcanic field. The facilities of NTS are widely distributed across this desert setting.

The area surrounding NTS is unpopulated to sparsely populated desert and rural land. Access to areas that would have views of the site is controlled by NTS or the U.S. Air Force; therefore, few viewpoints are accessible to the general public. Public viewpoints of NTS along U.S. Route 95, the principal highway between Tonopah and Las Vegas, are limited to Mercury Valley due to the various mountain ranges surrounding the southern boundary of the site. The primary viewpoint in Mercury Valley is a roadside turnoff containing Nevada Historical Marker No. 165 of the Nevada State Park System, entitled "Nevada Test Site." NTS facilities within 8 kilometers (5 miles) are visible from this viewpoint. The main base camp at Mercury, located in Area 23, is well defined at night by facility lighting. Lands within NTS have a Visual Resource Contrast rating of Class II or III. Management activities within these classes may be seen, but should not dominate the view. Developed areas within the site are consistent with a Visual Resource Contrast Class IV rating in which management activities dominate the view and are the focus of viewer attention.

DAF is located in Area 6, which covers about 21,200 hectares (53,500 acres) between Yucca Flat and Frenchman Flat, straddling Frenchman Mountain. Developed areas are widespread. DAF is a 9,290-square-meter (100,000-square-foot) facility that has a low profile and is covered with a minimum of 1.5 meters (5 feet) of earth. Several small building and parking lots surround DAF itself. Areas within and immediately adjacent to the facility are bare ground; the site is surrounded by desert. As is the case for NTS as a whole, undeveloped portions of the Area 6 have a Visual Resource Contrast Class II or III, while developed portions, including DAF, have a Visual Resource Contrast Class IV rating.

### 4.4.2 Site Infrastructure

Site infrastructure characteristics for NTS are summarized in **Table 4–36**.

**Table 4–36 NTS Sitewide Infrastructure Characteristics**

| *Resource* | *Site Usage* | *Site Capacity* |
|---|---|---|
| **Transportation** | | |
| Roads (kilometers) | 1,127 [a] | Not applicable |
| Railroads (kilometers) | 0 | Not applicable |
| **Electricity** | | |
| Energy consumption (megawatt-hours per year) | 101,377 | 176,844 |
| Peak load (megawatts) | 27 | 45 |
| **Fuel** | | |
| Natural gas (cubic meters per year) | 0 | Not applicable |
| Liquid Fuels (liters per year) | 4,201,805 | Not limited |
| Coal (metric tons per year) | 0 | Not applicable |
| **Water (liters per year)** | 832,000,000 | 5,150,000,000 [b] |

[a] Includes paved and unpaved roads.
[b] Sustainable water production capacity of all site wells.
Sources: DOE 1996e, DOE 1998b, DOE 2000j.

#### 4.4.2.1 Ground Transportation

About 644 kilometers (400 miles) of paved roads have been developed out of the 1,127 kilometers (700 miles) of roads on the site (Table 4–36). There is no railway service connection to NTS. Local and linking transportation systems, including roadways, are detailed in Section 4.4.9.4.

#### 4.4.2.2 Electricity

Electric power is delivered to NTS at the Mercury switching center in Area 22 by a primary 138-kilovolt supply line from the Nevada Power Company system near Las Vegas. A second Nevada Power Company-owned 138-kilovolt line connects the Mercury switching center to the Jackass Flats substation in Area 25. Valley Electric Cooperative, serving the Pahrump, Nevada, area, also has a transmission connection to the Jackass Flats substation. The dual transmission and station connections provide NTS with the ability to receive service from either transmission source depending on contractual arrangements. A DOE-owned 138-kilovolt loop extends this primary power supply into NTS forward areas where smaller, lower-voltage distribution lines feed power to individual facilities. During the last several years, NTS has been provided power under contracts with Nevada Power Company and the Western Area Power Administration. Additionally, DOE has periodically operated oil-fired diesel generators at Area 25 for peak and back-up power supply purposes. Electric power at NTS is carried over 426 kilometers (265 miles) of transmission and subtransmission lines.

NTS electrical capacity is about 177,000 million megawatt-hours per year. In 2000, NTS electrical usage was about 101,000 megawatt-hours (Table 4–36). Peak load usage is 27 megawatts with a site peak load capacity of 45 megawatts (DOE 1996g).

#### 4.4.2.3 Fuel

Liquid fuels are the principal fuel resources used at NTS (DOE 1996g). No coal or natural gas is used. Unleaded gasoline and diesel fuel are available at NTS. The fuel capacity in Mercury is 45,424 liters (12,000 gallons) of unleaded gasoline and 37,853 liters (10,000 gallons) of diesel fuel. The bulk fuel storage capacity in Mercury is 1,589,826 liters (420,000 gallons) of both unleaded gasoline and diesel fuel. The fuel capacity in Area 6 is 75,706 liters (20,000 gallons) for both unleaded gasoline and diesel fuel. The bulk fuel storage capacity in Area 6 is 158,983 liters (42,000 gallons) of unleaded gasoline and 397,457 liters (105,000 gallons) of diesel fuel. The fuel capacity in Area 12 is 75,706 liters (20,000 gallons) of unleaded gasoline (DOE 1998b).

NTS used approximately 4.2 million liters (1.1 million gallons) of liquid fuels in 2000. In 2000, DAF used about 83,000 liters (22,000 gallons) of liquid fuels.

#### 4.4.2.4 Water

NTS is presently served by a water system divided into four service areas consisting of 11 wells for potable water, two wells for nonpotable water, some 30 usable storage tanks, 13 usable construction water sumps, and 6 water transmission systems (with 4 permitted water distribution systems and 3 permitted water trucks in 1999). One potable well (Well C) was inactive again in 1998 due to a failed pump (DOE 2000j). The wells are not being used to their full capacity and are capable of producing much more water if needed. Additional inactive wells are available, or wells may be drilled and developed if increased water production is required. Wells, sumps, and storage tanks are used, as required, to support construction or operational activities. Domestic, construction, and fire protection water are supplied by this system through over 161 kilometers (100 miles) of supply line. Potable water is trucked to support facilities that are not connected

to the potable water system. The maximum production capacity of the site potable supply wells is approximately 8.0 billion liters (2.1 billion gallons) per year. The sustainable site production capacity has been estimated at a level of approximately 5.15 billion liters (1.36 billion gallons) annually which equates to the historical maximum production level without measurable impact on the regional groundwater system. NTS has adopted this production level and hydrographic basin-specific levels for planning purposes in accordance with sound resource management principals (DOE 1998b). Water rights appropriated under the Federal Reserve Water Rights Doctrine essentially grants an unquantified water right to support NTS missions. However, downgradient groundwater users have challenged DOE's water rights under the states water appropriations process (DOE 1998b). NTS used approximately 832 million liters (219.8 million gallons) of water in 1999 (DOE 2000j).

Area 6 of NTS is in water service area C which also encompasses Areas 1, 3, 5, 11, 22, 23, 26, and 27. Supply wells 4, 4a, C, and C1 provide potable water service to facilities in these areas including DAF. Combined, these wells have a maximum production capacity of approximately 2.55 billion liters (672 million gallons) per year (DOE 1998b).

### 4.4.3 Air Quality

The climate at NTS is characterized by limited precipitation, low humidity, and large diurnal temperature ranges. The lower elevations are characterized by hot summers and mild winters, which are typical of other Great Basin areas. As elevation increases, precipitation increases and temperatures decrease.

Annual precipitation at higher NTS elevations is about 23 centimeters (9 inches), including snow accumulations. The lower elevations receive approximately 15 centimeters (6 inches) of precipitation annually, with occasional snow accumulations lasting only a few days.

Precipitation in the summer falls in isolated showers, which cause large variations among local precipitation amounts. Summer precipitation occurs mainly in July and August, when intense heating of the ground beneath moist air masses triggers thunderstorm development and associated lightning. A tropical storm occasionally will move northeastward from the coast of Mexico, bringing heavy precipitation during September and October.

Elevation influences temperatures at NTS. At an elevation of 2,000 meters (6,560 feet) on Pahute Mesa, the average daily maximum and minimum temperatures are 4 °C to -2 °C (40 °F to 28 °F) in January and 27 °C to 17 °C (80 °F to 62 °F) in July. In the Yucca Flat weapons test basin, at an elevation of 1,195 meters (3,920 feet), the average daily maximum and minimum temperatures are 11 °C to -6 °C (51 °F to 21 °F) in January, and 36 °C to 14 °C (96 °F to 57 °F) in July. Elevation at Mercury is 1,314 meters (4,310 feet), and the extreme temperatures are 21 °C to -11 °C (69 °F to 12 °F) in January and 43 °C to 15 °C (109 °F to 59 °F) in July.

The annual average temperature in the NTS area is 19 °C (66 °F). Monthly average temperatures range from 7 °C (44 °F) in January to 32 °C (90 °F) in July. Relative humidity readings (taken four times per day) range from 11 percent in June to 55 percent in January and December.

Average annual wind speeds and direction vary with location. At higher elevations on Pahute Mesa, the average annual wind speed is 4.5 meters per second (10 miles per hour). The prevailing wind direction during winter months is north-northeasterly, and during summer months winds are southerly.

In the Yucca Flat weapons test basin, the average annual wind speed is 3 meters per second (7 miles per hour). The prevailing wind direction during winter months is north-northwesterly, and during summer

months is south-southwesterly. At Mercury, the average annual wind speed is 4 meters per second (8 miles per hour) with northwesterly prevailing winds during winter months, and southwesterly prevailing winds during summer months.

Wind speeds in excess of 27 meters per second (60 miles per hour), with gusts up to 48 meters per second (107 miles per hour), may be expected to occur once every 100 years. Additional severe weather in the region includes occasional thunderstorms, lightning, tornadoes, and sandstorms. Severe thunderstorms may produce high precipitation that continues for approximately one hour and may create a potential for flash flooding. Few tornadoes have been observed in the region, and they are not considered a significant event. The estimated probability of a tornado striking a point at NTS is extremely low (3 in 10 million years).

#### 4.4.3.1 Nonradiological Releases

NTS is located in Nevada Intrastate Air Quality Control Region (#147). The region has been designated as attainment with respect to the National Ambient Air Quality Standards (NAAQS). The nearest nonattainment area is the Las Vegas area, located 105 kilometers (65 miles) southeast of NTS. Las Vegas Valley Hydrographic Area 212, located in Clark County, is classified as moderate nonattainment for carbon monoxide and serious nonattainment for fugitive dust ($PM_{10}$). The remaining portion of Clark County is designated as unclassifiable/attainment for these pollutants (40 CFR Part 81.329).

The nearest Prevention of Significant Deterioration Class I areas to NTS are the Grand Canyon National Park, 208 kilometers (130 miles) to the southeast, and the Sequoia National Park, 169 kilometers (105 miles) to the southwest. NTS has no sources subject to Prevention of Significant Deterioration requirements.

The criteria air pollutants emitted at NTS include particulates from construction, aggregate production, surface disturbances, and fugitive dust from vehicles traveling on unpaved roads; various pollutants from fuel-burning equipment, incineration, and open burning; and volatile organics from fuel storage facilities. A summary of emission estimates for sources at NTS is presented in **Table 4–37**. Emissions of hazardous air pollutants from current NTS sources are below regulatory requirements.

**Table 4–37 NTS Source Emission Inventory in 1993**

| *Pollutant* | *Source* | *Emissions (kilograms per hour)* |
|---|---|---|
| $PM_{10}$ | Area 12 boiler | 1.3 |
| | Area 23 boiler | 1.6 |
| | Area 23 boiler | 1.3 |
| | Area 23 incinerator | 0.34 |
| | Area 6 boiler | 1.3 |
| | Area 1 rotary dryer | 3.2 |
| Sulfur dioxide | Area 12 boiler | 1.3 |
| | Area 23 boiler | 1.4 |
| | Area 23 boiler | 1.3 |
| | Area 23 incinerator | 1.4 |
| | Area 6 boiler | 1.1 |

$PM_{10}$ = particulate matter less than or equal to 10 microns in aerodynamic diameter.
Source: DOE 1996e.

Ambient air quality at NTS is not currently monitored for criteria pollutants or hazardous air pollutants, with the exception of radionuclides. Elevated levels of ozone or particulate matter may occasionally occur because of pollutants transported into the area or because of local sources of fugitive particulates. Ambient concentrations of other criteria pollutants (sulfur dioxide, nitrogen oxides, carbon monoxide, and lead) are

probably low because there are no large sources of these pollutants nearby. The nearest area with air pollutant sources of concern is the Las Vegas area. Ambient air quality data for NTS is summarized in **Table 4–38**. These measurements were recorded during the period from August 15 through September 15, 1990. Monitoring stations were located in Area 23 at Building 525; Area 6 at Building 170; and Area 12 at the sanitation department office trailer. DAF is located in Area 6. Based on the data collected during this study, NTS is well within all applicable Federal and state ambient air quality standards.

**Table 4–38 Ambient Air Quality Data for NTS [a]**

| *Pollutant* | *Averaging Period* | *Most Stringent Standard [b] (micrograms per cubic meter)* | *Monitored Concentration (micrograms per cubic meter)* | | |
|---|---|---|---|---|---|
| | | | *Area 23* | *Area 6* | *Area 12* |
| Carbon monoxide | | | | | |
| less than 5,000 feet above mean sea level | 8 hours | 10,000 | 1,370 | 1,150 | 2,290 |
| at any elevation | 1 hour | 40,000 | 1,370 | 1,950 | 2,750 |
| Lead | Quarterly | 1.5 | (d) | (d) | (d) |
| Nitrogen dioxide | Annual | 100 | (d) | (d) | (d) |
| Ozone [c] | 1 hour | 235 | (d) | (d) | (d) |
| $PM_{10}$ | Annual | 50 | (d) | (d) | (d) |
| | 24 hours | 150 | 78.3 | 20.2 | 45.4 |
| Sulfur dioxide | Annual | 80 | (d) | (d) | (d) |
| | 24 hours | 365 | 39.3 | (d) | 15.7 |
| | 3 hours | 1,300 | 65.4 | (d) | 52.4 |

$PM_{10}$ = particulate matter less than or equal to 10 microns in aerodynamic diameter

[a] Nevada also has ambient standards for visibility and hydrogen sulfide. Measurements recorded from August 15 to September 15, 1990.

[b] The more stringent of the Federal and state standards is presented if both exist for the averaging period. The NAAQS (40 CFR Part 50), other than those for ozone, particulate matter, lead, and those based on annual averages, are not to be exceeded more than once per year. The annual arithmetic $PM_{10}$ mean standard is attained when the expected annual arithmetic mean concentration is less than or equal to the standard.

[c] Another standard applies at Lake Tahoe Basin.

[d] Not measured.

Sources: Nevada Administrative Code 445B.391, DOE 1996e.

The existing ambient air concentrations attributable to sources at NTS are expected to represent a small percentage of the ambient air quality standards. No modeled concentrations are available showing the site contributions to ambient concentrations at the site boundary.

### 4.4.3.2 Radiological Releases

During 1998, an estimated 363 curies of tritium and 0.24 curies of plutonium-239/240 were released to the atmosphere at NTS. These releases were attributed to: (1) diffusion of tritiated water vapor from evaporation from tunnel and characterization well containment ponds, (2) diffuse emissions calculated from the results of environmental surveillance activities, and (3) resuspension of plutonium as measured with air sampling equipment or calculated by use of resuspension equations. The releases and their sources are presented in **Table 4–39**. None of the releases were from Area 6, where DAF is located.

**Table 4–39 Radiological Airborne Releases to the Environment at NTS in 1999**

| *Radionuclide* | *Source* | *Release (curies)* |
|---|---|---|
| Tritium (Hydrogen-3) | Containment ponds | 24.7 [a] |
| | Laboratories | 5.7 |
| | SCHOONER | 65 |
| | Sedan Crater, Area 10 | 260 |
| | Area 5, Radioactive Waste Management Site | 7.1 |
| Plutonium-239/240 | Areas 3 and 9 | 0.04 |
| | Other Areas [b] | 0.20 |

[a] Evaporation from the containment ponds.
[b] There were no radioactive releases from Area 6 in 1999.
Source: DOE 2000j.

### 4.4.4 Noise

The major noise sources at NTS include equipment and machines (e.g., cooling towers, transformers, engines, pumps, boilers, steam vents, paging systems, construction and material-handling equipment, and vehicles), blasting and explosives testing, and aircraft operations. No NTS environmental noise survey data are available. At the NTS boundary, away from most facilities, noise from most sources is barely distinguishable above background noise levels.

The acoustic environment in areas adjacent to NTS can be classified as either uninhabited desert or small rural communities. In the uninhabited desert, the major sources of noise are natural physical phenomena such as wind, rain, and wildlife activities, and an occasional airplane. The wind is the predominant noise source. Desert noise levels as a function of wind have been measured at an upper limit of 22 decibels A-weighted (dBA) for a still desert and 38 dBA for a windy desert.

A background sound level of 30 dBA is a reasonable estimate. This is consistent with other estimates of sound levels for rural areas. The rural communities day-night average sound level has been estimated in the range of 35 to 50 decibels (dB) (EPA 1974). A background sound level of 50 dB is a reasonable estimate for Mercury.

Except for the prohibition of nuisance noise, neither the State of Nevada nor local governments have established specific numerical environmental noise standards.

### 4.4.5 Geology and Soils

NTS and surrounding areas are in the southern part of the Great Basin, the northern most subprovince of the Basin and Range Physiographic Province. This region is generally characterized by more or less regularly spaced, generally north-south trending mountain ranges separated by alluvial basins that were formed by faulting. The Great Basin subprovince is a closed drainage basin, i.e., precipitation that falls over the basin has no outlet to the Pacific Ocean. The relief of NTS is considerable, ranging from less than 1,000 meters (3,280 feet) above sea level in Frenchman Flat and Jackass Flats to about 2,339 meters (7,675 feet) on Rainier Mesa. There are three primary valleys at NTS: Yucca Flat, Frenchman Flat, and Jackass Flats. Both Yucca Flat and Frenchman Flat are topographically closed, with playas in the lowest portions of each basin. Jackass Flats is topographically open with drainage via the Fortymile Wash off NTS.

The topography of NTS has been altered by historic DOE actions, particularly underground nuclear testing. The principal effect of testing has been the creation of numerous craters in Yucca Flat basin and a lesser number of craters on Pahute and Rainier Mesas.

NTS is underlain by a thick section (more than 10,597 meters [34,768 feet]) of Paleozoic (Permian to Cambrian) age (245 to 570 million years old) and older sedimentary rocks, locally intrusive Cretaceous age (66 to 145 million years old) granitic rocks, a variable assemblage of middle to late Tertiary (Miocene) age (5 to 24 million years old) volcanic rocks, and locally thick deposits of postvolcanic sands and gravels that fill the present day valleys. Additional details about NTS site geology are presented in the *NTS SWEIS*.

Extensive rock and mineral resources are present in the NTS region. A number of mines were developed into districts within the region from the early 1900s to the late 1970s. Significant gold and silver deposits may be present east of Goldfield in the northwestern Nellis Air Force Range Complex located north of NTS. Small amounts of tungsten were produced from the Oak Spring mining district at the north end of Yucca Flat, and silver, copper, lead, zinc, molybdenum sulfides are also known to be present. Economic quantities of silver, copper, lead, and zinc have been recovered from the Groom mine in this area. The Calico Hills and Mine Mountain mining districts within NTS exhibit copper, silver, lead, zinc, and mercury sulfides in fractured carbonate and clastic rocks. Free gold with silver sulfides occurs at the surface associated with mine workings developed within the Wahmonie mining district located east of Jackass Flats and north of Skull Mountain. Industrial minerals such as uranium may be present in the northwestern part of the Nellis Air Force Range Complex. Other potential industrial mineral resources include barite and possibly fluorite. Most of the alluvial valleys in the region have aggregate resources at least along the flanks of adjacent mountains. NTS is considered a valuable source of these resources to meet future demand. Hot springs are common in the province and, if water temperatures near Yucca Mountain are representative, water temperatures in the region may be insufficient for commercial geothermal power development (DOE 1998b).

NTS is also crossed by numerous faults (**Figure 4–24**). Three major fault zones in the region may be currently active (Mine Mountain, Cane Spring, and Rock Valley) and thus are deemed capable per the U.S. Nuclear Regulatory Commission definition (10 CFR 100, Appendix A). Small earthquakes recently occurred at or near the Cane Spring Fault zone and the Rock Valley Fault zone, although no surface displacement was associated with either of these earthquakes. The Cane Spring fault is thought to have been the source of a magnitude 4.3 earthquake in August 1971. In February 1973, an earthquake of magnitude 4.5 occurred along the Rock Valley Fault System (DOE 1998b). A fault near Little Skull Mountain in the southwest part of NTS was the location of a magnitude 5.6 (Richter magnitude 5.7) earthquake on June 28, 1992. This is the largest earthquake recorded within the boundaries of NTS and may have resulted from a magnitude 7.5 earthquake near Landers, California, that occurred less than 24 hours earlier. Although there was no surface rupture, the Little Skull Mountain earthquake was the first to cause significant damage to facilities at NTS. These facilities, however, were built prior to the more stringent building codes presently followed at NTS. Nevertheless, another earthquake was epicentered below Little Skull Mountain on September 13, 1992 and registered Richter magnitude 4.1 to 4.4, but caused no damage. It had a Mercalli Intensity of IV (DOE 1998b, USGS 2001f).

Additionally, Yucca Fault in the Yucca Flat weapons test basin has been active in the recent geologic past (Figure 4–24). This fault displaces surface alluvium by as much as 18 meters (60 feet). Displacement of this young surface alluvium indicates that movement on Yucca Fault has occurred within the last few thousand to tens of thousands of years; subsurface displacement along this fault is 213 meters (700 feet).

Seismic waves from nuclear explosions are believed to relieve tectonic stress, as manifested by earthquakes deeper than 3 kilometers (1.2 miles), aftershocks, and reactivation of nearby faults in the areas designated for nuclear device testing. Studies of nuclear-explosive tests show that these events can generate vertical and horizontal displacements on nearby existing faults. As much as 102 centimeters (40 inches) of vertical displacement and 15 centimeters (6 inches) of horizontal displacement have been observed. Parts of both the Yucca Fault and the Carpetbagger Fault have been reactivated from nearby testing of nuclear devices.

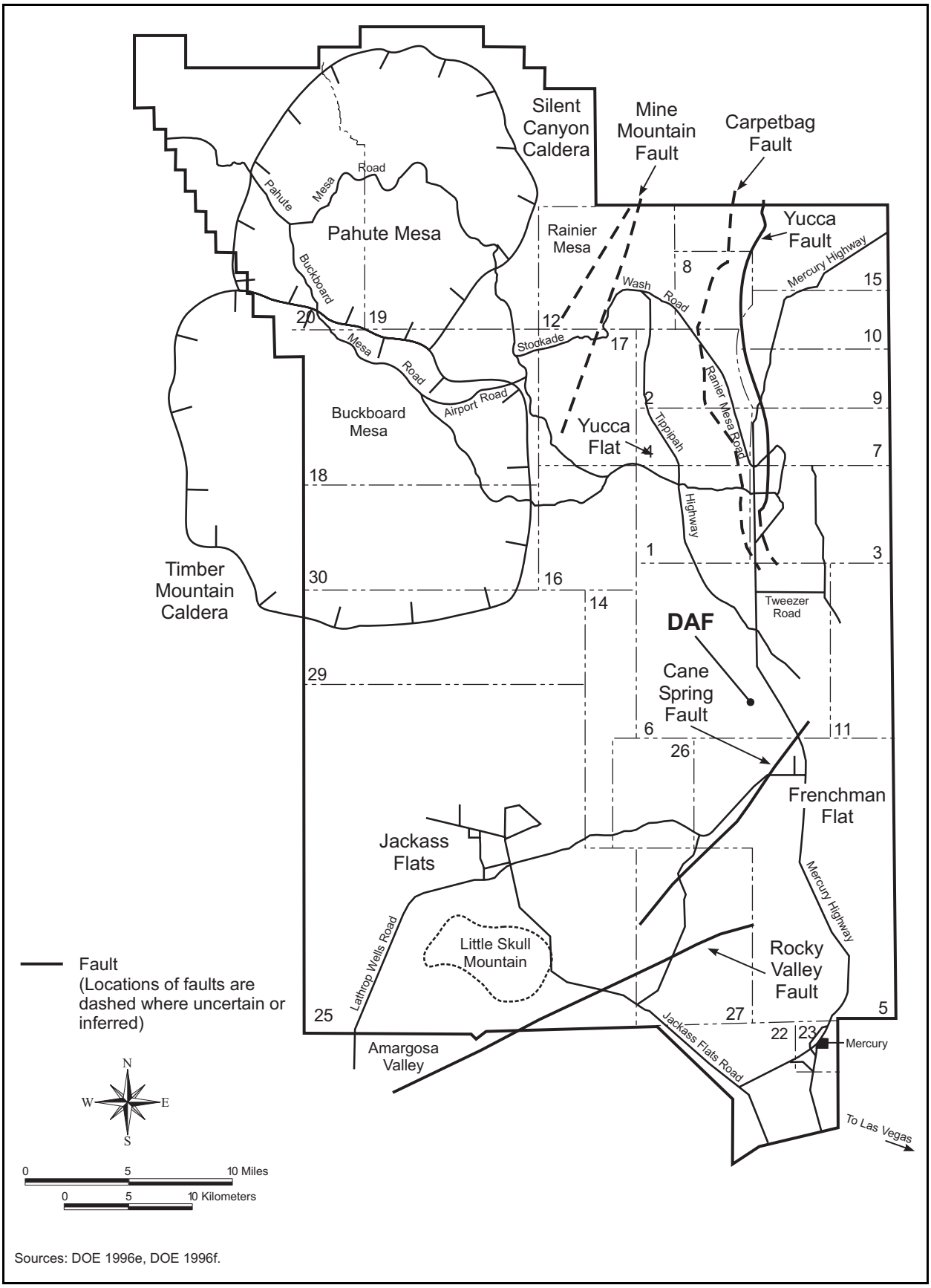


**Figure 4–24 Major Faults at NTS**

NTS lies in a region with relatively high seismicity and, as referenced above, the site is tectonically active. Within a radius of 100 kilometers (62 miles) of NTS (as measured from Area 6), a total of 7 significant earthquakes (i.e., having a magnitude of at least 4.5 or a Modified Mercalli Intensity of VI or larger) of natural origin have been documented. The largest of these was a Richter magnitude 5.13 earthquake in May 1967 centered 93 kilometers (58 miles) east-northeast of the site. None have been centered closer than 66 kilometers (41 miles) away (USGS 2001f). Since 1973, about 280 earthquakes in total (excluding those attributed to nontectonic sources) have been recorded within 100 kilometers (62 miles) of NTS, with the majority ranging in magnitude from 3 to 4 (USGS 2001g). Most notably, the June 29, 1992, magnitude 5.6 event located in the southwest portion of the site near Skull Mountain produced a maximum acceleration of 0.21g at Amargosa Valley (DOE 1996g). A Modified Mercalli Intensity was not attributed to this event (USGS 2001g). Also note that this earthquake is not listed among the significant earthquakes in the region despite its magnitude (USGS 2001f). Nevertheless, the region has remained seismically active. In calendar year 2000, there were four earthquakes recorded within 100 kilometers (62 miles) of the site. The closest of these was a September 9, 2000, Richter magnitude 3.0 event centered 27 kilometers (17 miles) southwest of Area 6 again near Little Skull Mountain (USGS 2001g). For reference, a comparison of Modified Mercalli Intensity (the observed effects of earthquakes) with measures of earthquake magnitude and ground acceleration is provided in Section F.5.2 (see Appendix F).

As discussed in more detail in Section 4.2.5, the U.S. Geological Survey has developed new earthquake hazard maps that are based on spectral response acceleration. These maps have been adapted for use in the new International Building Code (ICC 2000) and depict maximum considered earthquake ground motion of 0.2- and 1.0-second spectral response acceleration, respectively, based on a 2 percent probability of exceedance in 50 years (i.e., 1 in 2,500). NTS is calculated to lie within the 0.58g to 0.59g mapping contours for a 0.2-second spectral response acceleration and the 0.18g to 0.19g contours for a 1.0-second spectral response acceleration. For comparison, the calculated peak ground acceleration for the given probability of exceedance is approximately 0.26g (USGS 2001e).

Eruptions of the southwest Nevada volcanic field occurred primarily in the Middle Tertiary Period (around 24 million years ago). Successive eruptions produced no less than seven large and partially overlapping calderas, which were filled with lava flows and blanketed by vast deposits of volcanic tuff. As silicic volcanism that produced the large-volume ash flows of the Nevada volcanic field ended, basaltic volcanism began in the region about 11 million years ago. The episodes of basaltic volcanism were relatively low-volume and less explosive as compared to the earlier silicic eruptions (DOE 1999d). The basaltic eruptions produced small volcanoes and cinder cones that can be found in Crater Flat to the west of NTS (DOE 1999d). The youngest of these features is the Lathrop Wells volcano that could be as little as 75,000 years old. Expert analyses performed for the Yucca Mountain Project estimate that the probability of basaltic lava activity impacting the Yucca Mountain Repository located near the southwest boundary of NTS is about 1 in 7,000 over the first 10,000 years of repository operations (DOE 1999d). NTS lies about 240 kilometers (150 miles) southeast of the Long Valley area of California that has the potential for a volcanic eruption of the Mt. St. Helens type (DOE 1996g).

Soil studies to characterize site conditions have been limited at NTS. Soil loss through wind and water erosion is a common occurrence throughout NTS and surrounding areas. Limited areas of soils can be irrigated on NTS, and these occur only in the lower elevations of the Yucca Flat weapons test basin, Frenchman Flat, and Jackass Flats. Elsewhere on NTS, the soils are generally very limited in both thickness and areal extent. In general, soils across NTS have low available water-holding capacities and soil textures that are gradational from coarse-grained soils near the mountain fronts to fine-grained soils in the playa areas of the Yucca Flat weapons test basin and Frenchman Flat. Most soils are underlain by a hardpan of caliche in the lower elevations. Soil salinity generally increases dramatically in the direction of the playa areas, with the highest level of soluble salts accumulating in the deeper soil profile horizons in Frenchman Flat. The

potential for soil erosion and shrink-swell also increases into the playas and basins, with the potential for water erosion increasing with slope. There is no prime farmland at NTS (DOE 1996g).

Soils on portions of NTS have been contaminated during the conduct of various testing and ancillary operations. The largest areas of surficial contamination are in the Yucca Flat weapons test basin, Frenchman Flat, Plutonium Valley, and in scattered locations in the western and northwestern parts of the facility. A comprehensive investigation is underway to determine the risks associated with this soil contamination, and actions will be taken as part of the environmental restoration program to reduce these risks, as appropriate.

DAF in NTS Area 6 is located on the northern boundary of Frenchman Flat. The nearest capable fault to DAF is the Cane Spring Fault, which is located about 5 kilometers (3 miles) southeast of the facility site (Figure 4–23). Surficial stratigraphy is dominated primarily by alluvial sediments that attain a thickness of approximately 332 meters (1,090 feet) near the DAF (NTS 2001).

### 4.4.6 Water Resources

#### 4.4.6.1 Surface Water

NTS is located within the Great Basin, a closed hydrographic basin from which no surface water leaves except by evaporation. The Great Basin includes much of Nevada. There are no perennial streams or other naturally-occurring surface water bodies at NTS. Streams (arroyos) in the region are ephemeral. Runoff results from snowmelt and from precipitation during storms that occur most commonly in winter and occasionally in fall and spring, as well as during localized thunderstorms that occur primarily in the summer. Much of the runoff quickly infiltrates into rock fractures or into the surface soils before being lost by evapotranspiration. Some is carried down alluvial fans in arroyos, and some drains onto playas where it may stand for weeks as a lake. Runoff in the eastern half of the site ultimately collects in the playas (Yucca and Frenchman Lakes) of Yucca Flat and Frenchman Flat, respectively (**Figure 4–25**). In the northeastern portion, runoff drains off the site and onto the Nellis Air Force Range Complex. In the western half and southernmost part of NTS, runoff is carried toward the Amargosa Desert (DOE 1996g). There are a number of springs on NTS, but seepage from springs travels only a short distance from the source before evaporating or infiltrating into the ground. In addition, there are a number of engineered waste disposal ponds and open reservoirs for industrial water on the site.

Intermittent streams within NTS are not classified, but are protected by the State of Nevada for specified uses in accordance with NAC 445A.199-445A.225. Surface water within NTS boundaries is not used. In fact, no public water supplies are drawn from springs in Amargosa Valley, which is located downgradient from NTS along the primary pathway for surface water flow. The closest surface water supply that is used for public consumption is Lake Mead, which supplies a large portion of the water demand of metropolitan Las Vegas. There are no NPDES permits for NTS because there are no wastewater discharges directly to onsite or offsite surface waters (DOE 2000j). However, discharges to sewage lagoons and ponds are regulated by the State of Nevada. Specifically, ten usable sewage treatment facilities on NTS operate under a state general permit (GNEV93001) issued by the Nevada Division of Environmental Protection. This permit was renewed for five years on December 7, 1999. NTS maintains compliance with required permits. Due to the reduced treatment efficiency noted in some sewage treatment lagoons, DOE plans to install septic systems in the affected areas which would be permitted under state operating permits (DOE 2000j).

The potential exists for sheet flow and channelized flow through arroyos to cause localized flooding throughout NTS. However, because of the size of NTS, no comprehensive floodplain analysis has been conducted to delineate the 100- and 500-year floodplains. Nevertheless, a rise in the surface elevation of any standing water on a playa creates a potential flood hazard. Playas in the Yucca Flat weapons test basin

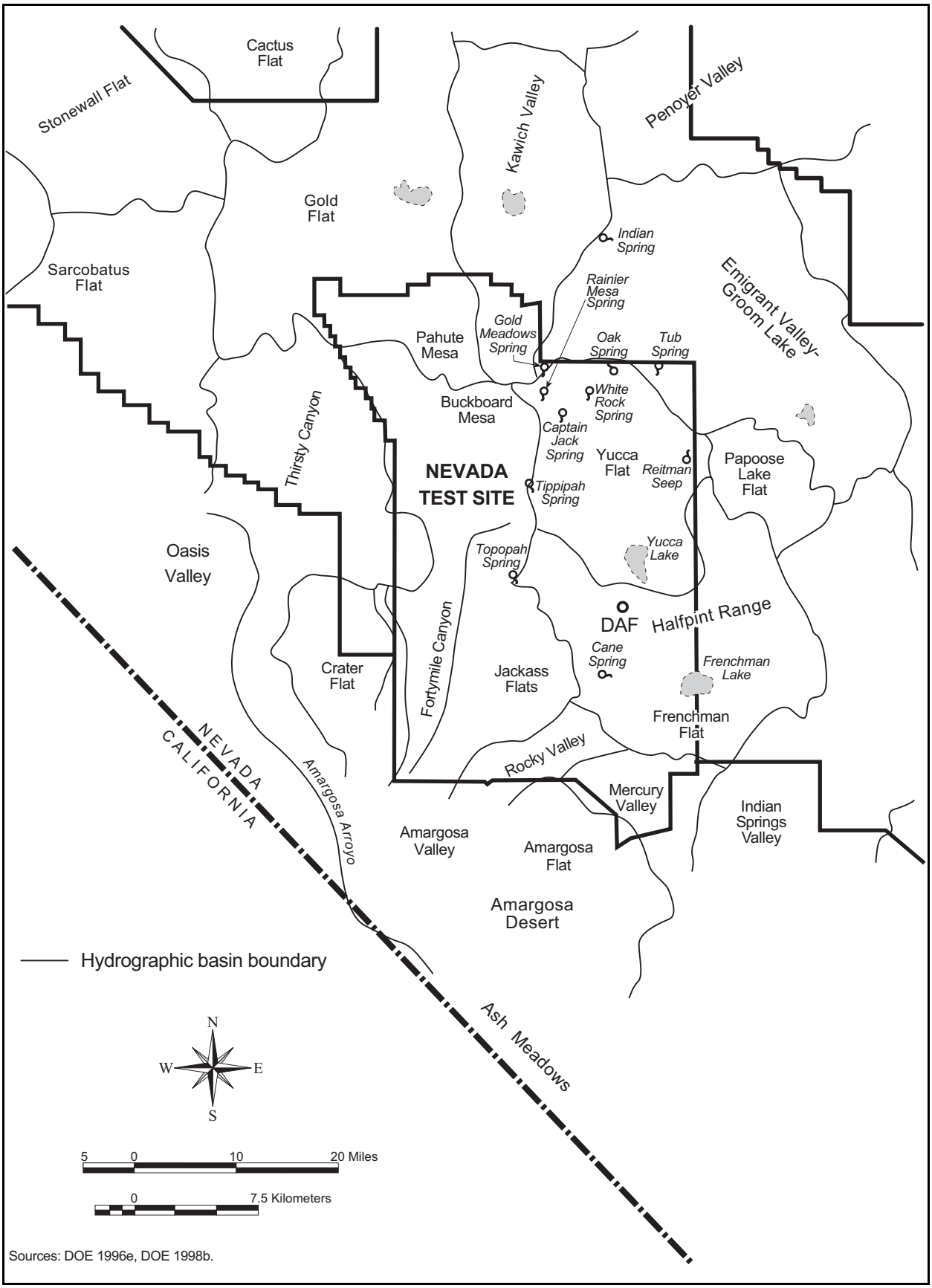


**Figure 4–25 Surface Water Features at the Nevada Test Site**

and Frenchman Flat in the northeastern and eastern parts of NTS, respectively, collect and dissipate runoff from their respective hydrographic basins. Several arroyos in the Yucca Flat weapons test basin pose a potential flood hazard to existing facilities as do arroyos on Frenchman Flat. Ground-surface disturbance and craters associated with underground nuclear tests have rerouted parts of natural drainage paths in areas of nuclear device testing. Some craters have captured nearby drainage, and headward erosion of drainage channels is occurring. However, this is considered to be negligible. In some areas of NTS, the natural drainage system has been all but obliterated by the craters. The western half and southernmost parts of NTS have arroyos that carry runoff beyond NTS boundaries during intense storms. Fortymile Canyon, the largest of these arroyos, originates on Pahute Mesa and intersects the Amargosa arroyo in the Amargosa Desert about 32 kilometers (20 miles) southwest of NTS. The Amargosa arroyo continues to Death Valley, California. Areas prone to flooding surround Fortymile Wash, a major tributary of Fortymile Canyon (Figure 4–24). Tonopah Wash, which runs southwesterly across Jackass Flats from Jackass Divide in the south-central part of NTS, is a major tributary to the Amargosa arroyo.

There are no named streams within the DAF area and no permanent, natural, surface water features near the area. An evaporation/percolation basin is located near the facility. Runoff from the site is conveyed via the natural topography east and southeast toward Frenchman Lake. This playa only retains standing water during the winter months. A storm water conveyance and diversion structure protects the facility and supporting structures from flooding and is designed for the probable maximum flood (DOE 1995d).

#### 4.4.6.2 Groundwater

Groundwater beneath NTS exists within three groundwater subbasins of the Death Valley Basin flow system. This flow system encompasses about 41,000 square kilometers (16,000 square miles) of the Great Basin. In particular, the eastern half of NTS is located within the Ash Meadows Subbasin, and the western half of the site lies largely within the Alkali Flat Furnace Creek Ranch Subbasin. In addition, a small section of the northwest corner of the site is located within the Pahute Mesa Oasis Valley Subbasin (DOE 1999d) (**Figure 4–26**). The groundwater section boundaries delineated in Figure 4–26 roughly correspond to the hydrographic areas mapped in Figure 4–25. Hydrographic areas are mapped on the basis of topographic divides and are the geographic unit used by the State of Nevada for the purposes of water appropriation and management. NTS lies within at least part of 10 of these areas (i.e., Gold Flat, Buckboard Mesa, Kawich Valley, Emigrant Valley, Oasis Valley, Yucca Flat, Jackass Flats, Frenchman Flat, Rock Valley, and Mercury Valley) (DOE 1999d).

The hydrogeology of the NTS region is rather complex. Nevertheless, three principal hydrogeologic systems are recognized. The first is the valley-fill alluvium that mostly consists of gravel, sand, silt, and clay alluvium and playa lake deposits of Quaternary to Late Tertiary age (i.e., recent to about 5 million years old). These deposits comprise the valley-fill aquifer. Volcanic rocks including rhyolite lava flow and welded and nonwelded ash flow tuff deposits of mainly middle to late Tertiary age (i.e., about 5 to 24 million years old) characterize the second system. This system encompasses the lava flow and welded-tuff aquifers. The last major system consists of sedimentary rocks ranging in age from Permian/Pennsylvania to Cambrian (i.e., 245 to 570 million years old) that include the limestones and dolostones comprising the upper and lower carbonate aquifers. Within these systems, six major aquifers and four major aquitards in the region have been defined. Groundwater quality within aquifers at NTS not affected by nuclear testing is generally acceptable for drinking water and industrial and agricultural uses. All hydrologic units that supply drinking water to NTS are classified as Class II groundwater (i.e., those that are currently used or are potentially available for drinking water or other beneficial uses) (DOE 1998b). The lower carbonate aquifer primarily represents the regional aquifer and is composed of 4,000 to 5,000 meters (13,120 to 16,400 feet) of relatively thick, permeable limestones and dolostones with thinner, less permeable siltstones, shales, and quartzites. However, the lower carbonate aquifer is not present in all areas, and rarely is the entire thickness of the unit

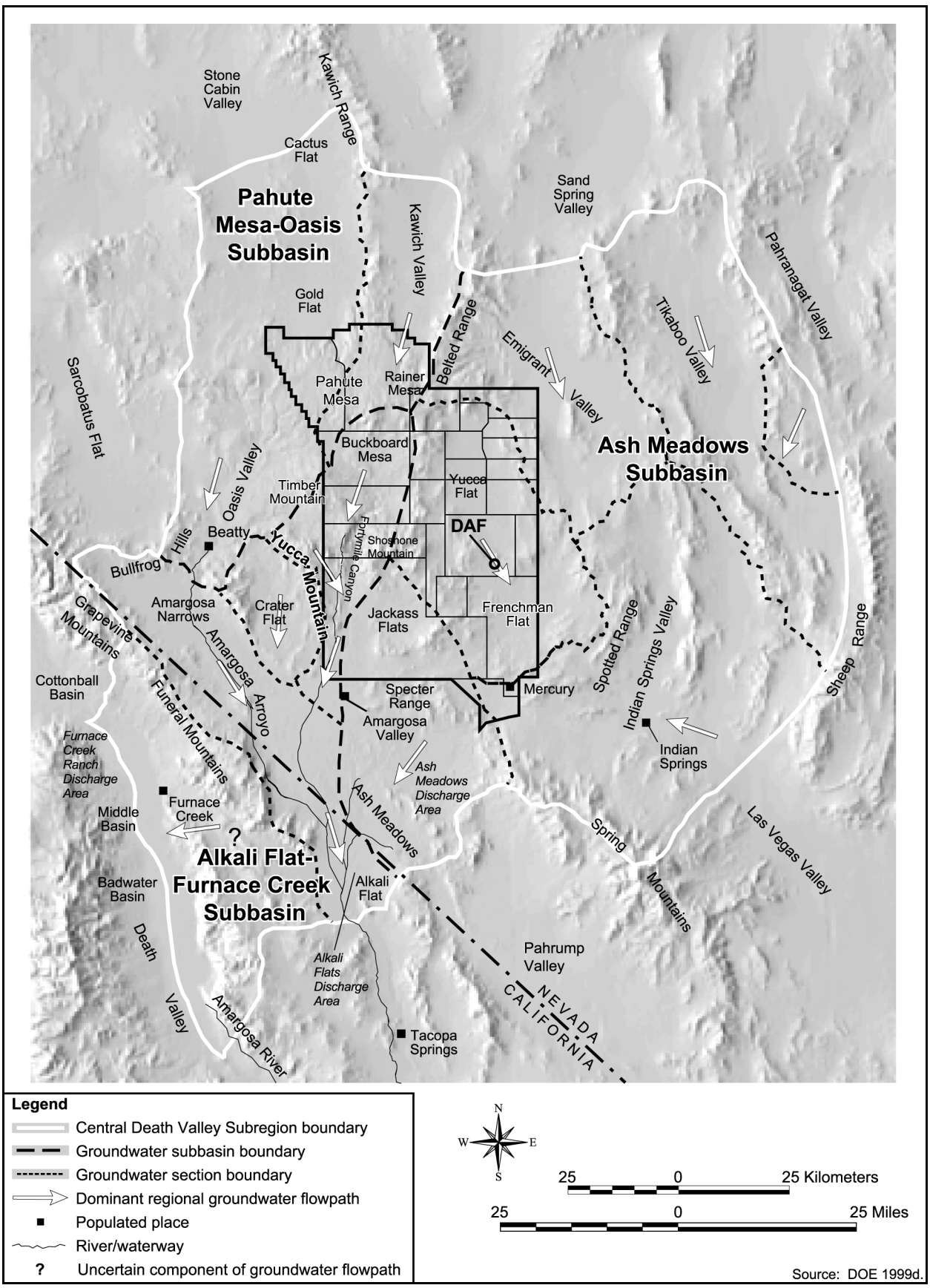


**Figure 4–26 Groundwater Hydrologic Regions of the Nevada Test Site and Vicinity**

present under NTS or adjacent areas. Generally, in the eastern half of the site, the water table occurs in the valley-fill alluvium and Tertiary volcanic rocks overlying the regional aquifer and predominantly in the volcanic aquifers across the western half of the site (DOE 2000j). Thinner sequences of these volcanic rocks overlie the upper carbonate aquifer and clastic confining units within some areas of the Yucca and Frenchman Flats.

The depth to groundwater in wells at NTS varies from about 79 meters (260 feet) below land surface in the extreme northwest part of the site and about 160 meters (525 feet) below land surface in portions of Frenchman Flat and the Yucca Flat weapons test basin to more than 610 meters (2,000 feet) under the upland portions of Pahute Mesa. Perched groundwater is known to occur in some parts of NTS, mainly in the volcanic rocks of the Pahute Mesa area. Groundwater flows generally south and southwest. The flow system extends from the water table to a depth that may exceed 1,494 meters (4,900 feet). The rates of flow are quite variable, with average flow rates over broad areas estimated to range from 2 to 201 meters per year (7 to 660 feet per year).

Recharge of the groundwater beneath NTS is primarily derived from underflow from basins upgradient from the site and from the infiltration of precipitation over upland areas on and upgradient from the site. Within the groundwater subbasins (Figure 4–26) of the Death Valley flow system, groundwater generally flows downgradient in a south-to-southwesterly direction with discharge occurring in the low-lying valleys as small springs or via evapotranspiration. These discharge locations are dictated by the presence of rocks of lower permeability and lower elevations. Two examples are the Ash Meadows and Alkali Flat discharge areas located south of NTS (Figure 4–26). The groundwater discharge from the Ash Meadows area is estimated at 21 million cubic meters (742 million cubic feet) per year. In contrast, groundwater discharge on NTS is more limited and occurs only as a few small springs from perched zones primarily located in the northern, upland areas of the site and from several wells.

Onsite water wells and select offsite wells are monitored in accordance with the Federal Safe Drinking Water Act and state regulations. Concurrently, DOE monitors onsite wells and select offsite wells for specific radionuclides. Approximately 30 monitoring wells and 10 springs are also sampled. Analytical results for all monitoring activities are published in the annual site environmental report (DOE 2000j).

The locations of 862 underground nuclear tests have been confirmed at NTS that correspond to areas of potential groundwater contamination (**Figure 4–27**). About one-third of these tests were at or below the water table and produced heavy metal and a wide range of radionuclide by-products. Detonations conducted near the water table have contaminated locally groundwater with over 60 radionuclides, with tritium being the most prevalent radionuclide. Additional information on activities being conducted under the site environmental restoration program to address contamination from underground nuclear testing is discussed in the annual site environmental report (DOE 2000j).

Drinking water at NTS is currently provided by 11 potable wells and is supplemented by bottled water in remote areas. Construction and fire-control water are supplied by two other wells in addition to the potable water supply wells. Springs and seeps are not used for water-supply purposes. DOE's water withdrawals have lowered water levels in the vicinity of water supply wells and have resulted in localized changes in groundwater flow direction. In general, the effects of pumping NTS water supply wells are concentrated within a distance of a few thousand feet of the operating wells. Water use is detailed in Section 4.4.2.4.

All water used at DAF in Area 6 is groundwater from four supply wells (C, C1, 4, and 4a). Wells 4 and 4a withdraw from volcanic aquifers at a depth of about 387 meters (1,270 feet), and wells C and C1 withdraw from the carbonate aquifers (upper and lower carbonate aquifers) from depths of 473 and 485 meters (1,552 and 1,591 meters), respectively. The depth to groundwater near the margins of Frenchman Flat in the

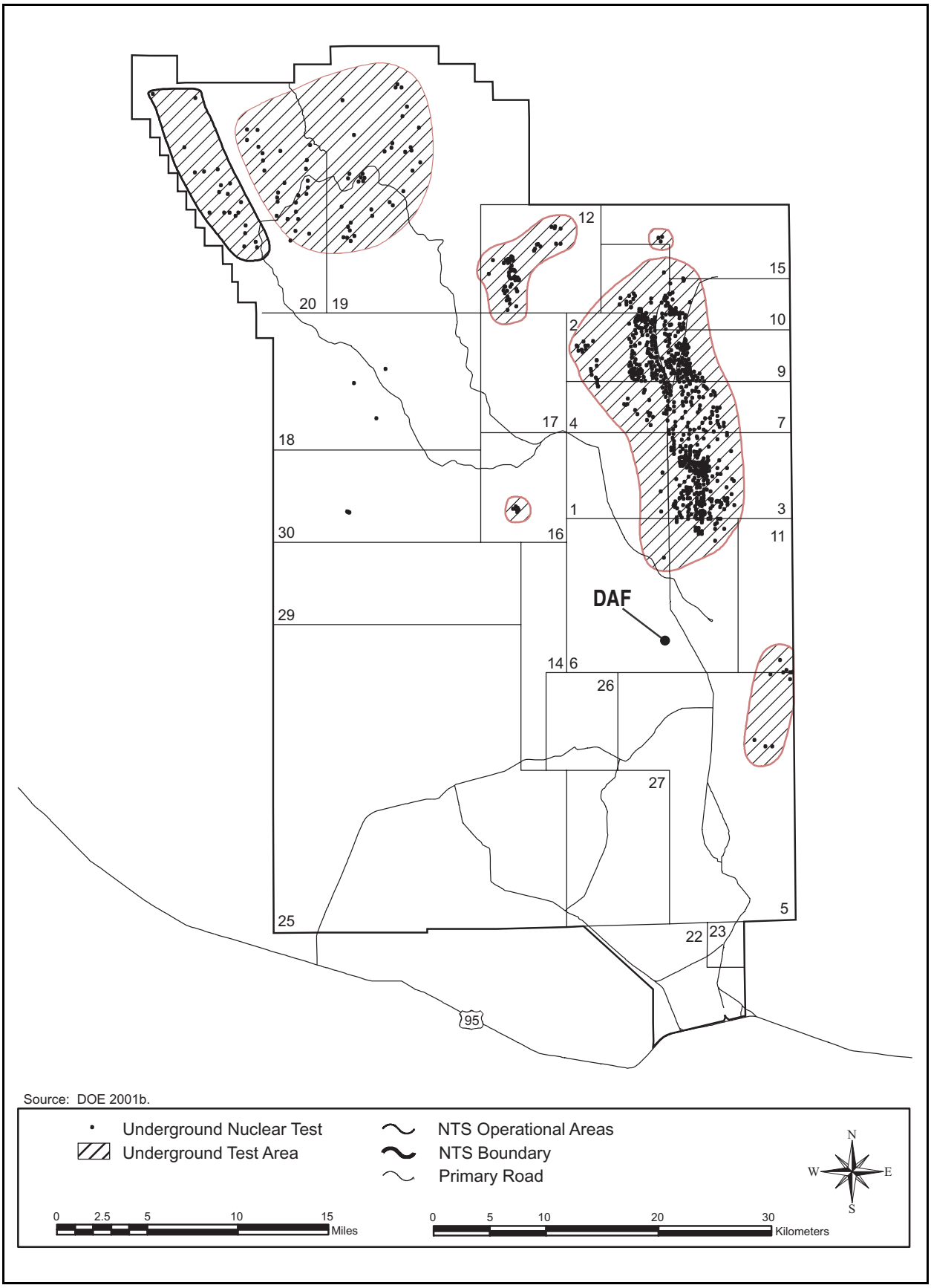


**Figure 4–27 Areas of Potential Groundwater Contamination on NTS**

vicinity of DAF is approximately 360 meters (1,180 feet) (DOE 1995d, DOE 2000j). The depth of the water table beneath DAF is approximately 280 meters (920 feet) (NTS 2001). The flow is generally to the southwest, but is locally variable.

### 4.4.7 Ecological Resources

#### 4.4.7.1 Terrestrial Resources

NTS is located along the transition zone between the Mojave and Great Basin deserts. As a result, it has a diverse and complex mosaic of plant and animal communities representative of both deserts, as well as some communities common only in the transition zone between these deserts (**Figure 4–28**). This transition zone extends to the east and west far beyond the boundaries of NTS. Thus, the range of almost all species found on the site also extends beyond the site, and there are few rare or endemic species present.

Mojave Desert plant communities are found at elevations below approximately 1,219 meters (4,000 feet) in Jackass Flats, Rock and Mercury Valleys, and Frenchman Flat. Creosote bush is the visually dominant shrub, and it is associated with a variety of other shrubs, depending on soil type and elevation. Two plant communities are unique to the transition zone. The first, which occurs at elevations from 1,219 to 1,524 meters (4,000 to 5,000 feet), is dominated by blackbrush. The second occurs in the bottom of enclosed Frenchman and Yucca Flat weapons test basins, where trapped winter air is too cold for typical Mojave Desert plants. The most abundant shrubs in these areas include three species of wolfberry. Little or no vegetation grows on the playas in these basins. Plant communities typical of the Great Basin Desert occur at elevations generally above 1,524 meters (5,000 feet). Communities dominated by saltbush, rabbitbrush, sagebrush, and pinyon pine/sagebrush occur with increasing elevation. Over 700 plant taxa have been found at NTS.

Two hundred seventy-nine species of terrestrial vertebrates have been recorded at NTS, including 54 species of mammals, 190 species of birds, and 33 species of reptiles. Typical Mojave Desert species found at the site include kit fox, Merriam's kangaroo rat, desert tortoise, chuckwalla, western shovelnose snake, and sidewinder snake. Typical Great Basin Desert species include cliff chipmunk, Great Basin pocket mouse, mule deer, northern flicker, scrub jay, Brewer's sparrow, western fence lizard, and striped whipsnake. About 60 wild horses live on the northern part of NTS. Water holes, both natural and manmade, are important to many species of wildlife, including game animals such as pronghorn and mule deer. Hunting is not permitted anywhere on NTS. Raptors such as the turkey vulture and rough-legged hawk and carnivores such as the long-tailed weasel and bobcat are two ecologically important groups on the site. A variety of migratory birds have been found at NTS (DOE 1996g). Migratory birds are protected under the Migratory Bird Treaty Act.

Vegetative communities that are found within Area 6 include those of both the Mojave Desert and transition zone. DAF is located within habitat most like that of the Mojave Desert. Gentle slopes cut by shallow arroyos 1 to 3 meters (3 to 10 feet) deep with shallow soils characterize the area. Facilities associated with DAF include a paved access road, a water storage tank, a diversion ditch uphill of the buildings, and sewage evaporation ponds. Whereas cleared areas have removed habitat for most animals of the site, the sewage evaporation ponds have provided unlimited water to birds of the region. Baseline biological studies associated with the facility, conducted in 1993 and 1994, identified 117 species of plants, 11 mammals, 71 birds, and 16 reptiles in the vicinity of DAF (DOE 1995a, DOE 1995b). Dominant plants were the Joshua tree and creosote bush. Common animals included the Merrian's kangaroo rat, long-tailed pocket mouse, mourning dove, house finch, black-throated sparrow, zebra-tailed lizard, and side-blotched lizard.

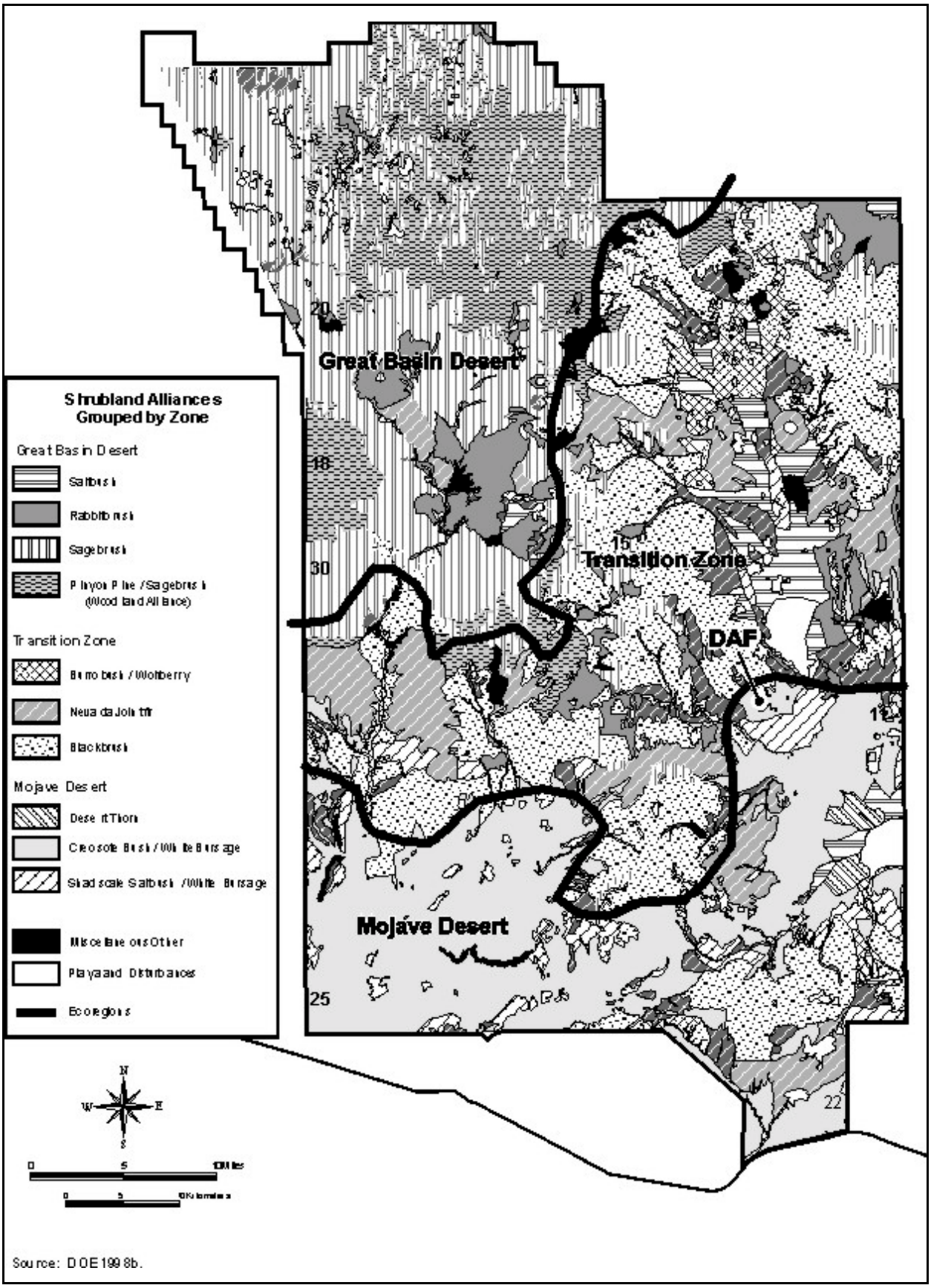


**Figure 4–28 Vegetation Association at NTS**

#### 4.4.7.2 Wetlands

There are at least 20 springs and seeps found at NTS, most of which support wetland vegetation such as cattail, sedges, and rushes. It is likely that these would constitute wetlands as defined under Section 4.04 of the Clean Water Act. One newly identified wetland, an historic borrow pit that catches water in large enough quantities and for long enough periods of time to sustain wetland vegetation, has been identified (DOE 1999g).

There is one natural water body found within Area 6 (DOE 1998b). It is located about 6.5 kilometers (4 miles) north of DAF. There are no wetlands located within the vicinity of DAF.

#### 4.4.7.3 Aquatic Resources

Known natural water sources on NTS consist of 24 springs and seeps, four tanks (natural rock depressions that catch and hold surface runoff), and one intermittent playa pond. Manmade impoundments on NTS, which are scattered throughout the eastern half of the site, support three introduced species of fish: bluegill, goldfish, and golden shiners. Eighty-one species of plants and 138 species of animals (not all of which are aquatic species) have been documented at or near aquatic sites on NTS (DOE 1999g).

There is one natural water body located in Area 6 about 6.5 kilometers (4 miles) north of DAF. However, sewage evaporation ponds are located at the DAF site (DOE 1995a). As noted above, these ponds are important to birds of the region.

#### 4.4.7.4 Threatened and Endangered Species

There are three agencies that have authority to designate threatened, endangered, and sensitive species in Nevada. The agencies are the USFWS, the Nevada Division of Wildlife, and the U.S. Forest Service. The U.S. Forest Service lists species for special management consideration on lands under their jurisdiction and protects these species under the authority of the Endangered Species Act of 1973.

The only Federally threatened species found at NTS is the Mojave Desert population of the desert tortoise (**Table 4–40**). Desert tortoises are found throughout the southern half of the site. The abundance of tortoises at NTS is low to very low compared to other areas within the range of this species. NTS contains less than 1 percent of the total desert tortoise habitat of the Mojave Desert population (DOE 1998b).

Area 6 is located within that part of the Mojave Desert which makes up the northernmost territory for the desert tortoise. No other threatened or endangered species have been found in the area around the DAF. In addition, no critical habitat has been identified in the area.

### 4.4.8 Cultural and Paleontological Resources

The current knowledge of cultural resources at NTS is the result of over 20 years of surveys and data recovery, most conducted prior to specific NTS activities taking place. In addition to preactivity surveys and studies, in 1990 DOE entered into a Programmatic Agreement with the State Historic Preservation Office and the Advisory Council for Historic Preservation, which implemented the *Long-Range Study Plan for Negating Potential Adverse Effects to Historic Properties on Pahute and Rainier Mesas*. As a result of these programs, 4.7 percent of the site (16,386 hectares [40,491 acres]) has been surveyed for cultural resources. Due to the restricted status of NTS over the past 50 years, site cultural resources have not been subjected to illegal collecting and/or damage from indiscriminate land uses of public lands. Most archaeological sites are in good condition. Based on current knowledge, all areas of NTS have the potential to contain

archaeological sites that are considered significant because they meet the eligibility criteria for the National Register of Historic Places.

**Table 4–40 Listed Threatened and Endangered Species, Species of Concern, and Other Unique Species that Occur or May Occur at NTS**

| *Species* | *Federal Classification* | *State Classification* | *Occurrence at NTS* |
|---|---|---|---|
| **Mammals** | | | |
| Fringed-myotis | Special Concern | Unlisted | Occasional |
| Long-eared myotis | Special Concern | Unlisted | Occasional |
| Long-legged myotis | Special Concern | Unlisted | Occasional |
| Pale Townsend's big-eared bat | Special Concern | Unlisted | Occasional |
| Pygmy rabbit | Special Concern | Unlisted | Potential habitat |
| Spotted bat | Special Concern | Protected by State of Nevada | Occasional |
| Small-footed myotis | Special Concern | Special Concern | Potential habitat |
| **Birds** | | | |
| American peregrine falcon | Special Concern | Unlisted | Occasional |
| Black tern | Special Concern | Special Concern | Potential habitat |
| Ferruginous hawk | Special Concern | Unlisted | Rare transient |
| Gray flycatcher | Special Concern | Unlisted | Potential habitat |
| Least bittern | Special Concern | Special Concern | Potential habitat |
| Lucy's warbler | Special Concern | Unlisted | Potential habitat |
| Phainopepla | Special Concern | Special Concern | Potential habitat |
| Western burrowing owl | Special Concern | Protected by State of Nevada | Resident |
| White-faced ibis | Special Concern | Protected by State of Nevada | Migrant |
| **Reptiles** | | | |
| Bandelier Gila monster | Special Concern | Special Concern | Potential habitat |
| Chuckwalla | Special Concern | Unlisted | Resident |
| Desert tortoise | Threatened | Protected by State of Nevada | Resident |
| **Plants** | | | |
| Beatley mild vetch | Special Concern | Endangered | Potential habitat |
| Beatley phacelia | Special Concern | Unlisted | Potential habitat |
| Black woolypod | Special Concern | Unlisted | Potential habitat |
| Cane Spring evening primrose | Special Concern | Unlisted | Potential habitat |
| Clokey's egg-vetch | Special Concern | Unlisted | Potential habitat |
| Death Valley beard tongue | Special Concern | Unlisted | Potential habitat |
| Delicate rock daisy | Special Concern | Special Concern | Potential habitat |
| Eastwood milkweed | Special Concern | Special Concern | Potential habitat |
| Kingston bedstraw | Special Concern | Unlisted | Potential habitat |
| Pahute Mesa beardtongue | Special Concern | Unlisted | Potential habitat |
| Pahute Mesa green gentian | Special Concern | Unlisted | Potential habitat |
| Parish's phacelia | Special Concern | Unlisted | Potential habitat |
| Sanicle biscuitroot | Special Concern | Unlisted | Potential habitat |
| White bearpoppy | Special Concern | Unlisted | Potential habitat |
| White-margined beardtongue | Special Concern | Unlisted | Potential habitat |

Source: DOE 1998b.

#### 4.4.8.1 Prehistoric Resources

Prehistoric sites found on NTS include habitation sites with wood and brush structures, windbreaks, rock rings, and cleared areas; rock shelters; petroglyphs (rock art); hunting blinds; rock alignments; quarries; temporary camps; milling stations; roasting ovens or pits; water caches; and limited activity locations (DOE 1996g). Approximately 1,615 prehistoric sites have been identified on NTS, of which about one-half are eligible for listing on the National Register of Historic Places. Most of the known prehistoric cultural resources are concentrated in the northern third of the site on Pahute and Rainier Mesas, and in the southwestern portion of the site in the Forty-Mile Canyon and Cat Canyon areas (DOE 1998b).

By 1998, 42 archaeological reconnaissance surveys covering approximately 1,228 hectares (3,305 acres) had been conducted within the Frenchman Flat hydrologic basin. This is the area within which the DAF is located. Ninety-five prehistoric sites were recorded as a result of these surveys. Of these sites, 2 are temporary camps, 2 are extractive localities, 38 are processing localities, 52 are localities, and 1 is a residential base. More recently, 1,089 hectares (2,690 acres) in Frenchman Flat in Area 6 were surveyed for cultural resources. No sites eligible for the National Register of Historic Places were found (DOE 2000a).

#### 4.4.8.2 Historic Resources

Historic site types on NTS include mines and prospects, trash dumps, settlements, campsites, ranches, homesteads, developed spring heads, roads, trails, and nuclear weapons developments sites. Sixty-five historic sites have been identified on NTS (DOE 1998b). One site, Sedan Crater, is listed on the National Register of Historic Places. Sedan Crater was created in 1962 as part of the Plowshare Program, whose aim was to identify peaceful uses for nuclear explosions. It is located in Yucca Flats. At least 600 buildings, structures, and objects dating to the Cold War era have been identified on NTS, but these have not been systematically recorded or evaluated for significance. Frenchman Flat and Yucca Flat are rich in significant structures of the atmospheric testing and Cold War eras, while the remaining portions of the site are less important with respect to historic sites from this period. One site considered eligible for listing is the Emigrant Trail, which traverses the southwest corner of NTS and was used by westward-bound pioneers of the nineteenth century. Additional historic sites may occur in unsurveyed portions of the site (DOE 1996g).

The DAF is located within the northern portion of Frenchman Flat. Four historic sites have been identified in the Frenchman Flat area. Two are of an unspecified historic nature and two are related to nuclear testing and research. The most recent archaeological survey of the Frenchman Flat area of Area 6, which covered 1,089 hectares (2,690 acres), did not identify any additional historic resources (DOE 2000a).

#### 4.4.8.3 Native American Resources

The Consolidated Group of Tribes and Organizations has had a long-standing relationship with DOE since 1987. The group is comprised of 16 Tribes and 3 official Native American organizations, representing the Southern Paiutes, Western Shoshones, and Owens Valley Paiutes. Each of these internal groups substantiated cultural and historic ties to NTS and the surrounding areas. The primary focus of the Consolidated Group of Tribes and Organizations has been the protection of traditional cultural resources. The organization has identified several sites at NTS that are important to Native American people, including storied rocks, rock shelters, wooden lodges, rock rings, springs, and certain archaeological sites. In addition, 107 plant and more than 20 animal species resident on NTS have been identified by Native American elders as part of their traditional resources. Due to the restricted access status of NTS for over 50 years, most of the site has not been impacted by grazing, mining, offroad vehicle travel, or other public uses. This has contributed significantly to the preservation of many cultural and biological resources that are important to Native Americans (DOE 1998b).

The Consolidated Group of Tribes and Organizations has stated that Frenchman Flat, where DAF is located, contains a wide variety of plants, animals, and archaeological sites of cultural importance to Native American people. A total of 20 plant species was identified at two plant study locations within the west-central portion of this area.

#### 4.4.8.4 Paleontological Resources

Alluvium-filled valleys surrounded by ranges composed of Precambrian and Paleozoic sedimentary rocks and Tertiary volcanic tuffs and lavas characterize the surface geology of NTS. Although the Precambrian sedimentary deposits contain no fossils or only a few poorly preserved fossils, the Paleozoic marine limestones are moderately to abundantly fossiliferous. Marine fossils found in the same Paleozoic formation on Nellis Air Force Range, adjacent to NTS to the north, include trilobites, conodonts, ostracods, solitary and colonial corals, brachiopods, cephalopods, algae, gastropods, and archaic fish. These fossils, however, are relatively common and have low research potential. Tertiary volcanic deposits are not expected to contain fossils (DOE 1996g).

Late Pleistocene terrestrial vertebrate fossils could be expected in Quaternary deposits. The possibility of finding mammoth, horse, camel, and bison remains might be expected because such fossils have been found at Tule Springs, 56 kilometers (35 miles) from the southern edge of NTS, as well as in Nye Canyon. Fossils found at Tule Springs include bison, deer, a small donkey-like horse, camel, Columbia mammoth, ground sloth, giant jaguar, bobcat, coyote, muskrat, and a variety of rabbits, rodents, and birds. Although no known fossil localities have been recorded to date on NTS, Quaternary deposits with paleontological materials may occur on the site (DOE 1996g).

As noted above, no known pleistocene fossil localities have been recorded to date on NTS, including the DAF area. Also, no fossils were discovered during construction of DAF. However, since paleontological surveys of the site have not been conducted, the possibility exists that Ice Age fossils could be found in Quaternary alluvium within the area.

### 4.4.9 Socioeconomics

Statistics for population, housing, community services, and local transportation are presented for the region of influence, a two-county area in Nevada (**Figure 4–29**) in which 97 percent of all NTS employees reside (**Table 4–41**). Within Clark County, most NTS employees reside in the Las Vegas area.

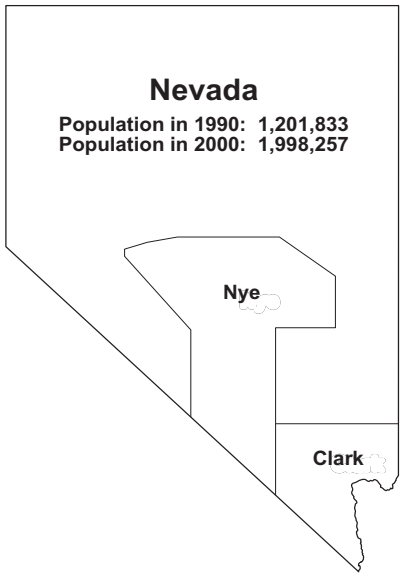


**Figure 4–29 Counties in the NTS Region of Influence**

#### 4.4.9.1 Regional Economic Characteristics

Between 1990 and 1999, the civilian labor force in the NTS region of influence increased 57.3 percent to the 1999 level of 664,889. In 1999, the annual unemployment average in the two-county area was 4.4 percent, which was the same as the annual unemployment average for Nevada (4.4 percent) (DOL 2000).

In 1998, service activities represented the largest sector of employment in the region of influence (45.1 percent). This was followed by retail trade (20.4 percent), and government

(10.4 percent). The totals for these employment sectors in Nevada were 42.4 percent, 20.5 percent, and 11.8 percent, respectively (NDETR 1999).

**Table 4–41 Distribution of Employees by Place of Residence in the NTS Region of Influence in 1994**

| *County* | *Number of Employees* | *Total Site Employment (percent)* |
|---|---|---|
| Clark | Not available | 90 |
| Nye | Not available | 7 |
| Region of influence total | Not available | 97 |

Source: DOE 1996e.

### 4.4.9.2 Demographic Characteristics

The 2000 demographic profile of the region of influence population is included in **Table 4–42**. Between 1990 and 2000, the region of influence population increased by 85.5 percent. The 2000 population was 1,408,250 people, of whom about 97.6 percent lived in Clark County. Persons self-designated as minority individuals comprised a 39.2 percent of the total population.

Income information for the NTS region of influence is included in **Table 4–43.** In 1997, the median household income in Clark County ($39,486) was higher than the Nye County median income ($36,580) and the Nevada state average of $39,280. Both counties had a larger percentage of persons living below the poverty lined compared to the state average.

**Table 4–42 Demographic Profile of the Population in the NTS Region of Influence**

| | *Clark County* | *Nye County* | *Region of Influence* |
|---|---|---|---|
| **Population** | | | |
| 2000 Population | 1,375,765 | 32,485 | 1,408,250 |
| 1990 Population | 741,368 | 17,781 | 759,149 |
| Percent Change from 1990 to 2000 | 85.6 | 82.7 | 85.5 |
| **Race (2000)** (Percent of Total Population) | | | |
| White | 71.6 | 89.6 | 72.0 |
| Black or African American | 9.1 | 1.2 | 8.9 |
| American Indian and Alaska Native | 0.8 | 2.0 | 0.8 |
| Asian | 5.3 | 0.8 | 5.2 |
| Native Hawaiian and Other Pacific Islander | 0.5 | 0.3 | 0.5 |
| Some other race | 8.6 | 3.0 | 8.5 |
| Two or more races | 4.2 | 3.1 | 4.2 |
| Percent Minority | 39.8 | 15.3 | 39.2 |
| **Ethnicity (2000)** | | | |
| Hispanic or Latino | 301,143 | 2,713 | 304,856 |
| Percent of Total Population | 22.3 | 8.4 | 21.6 |

Source: DOC 2001.

**Table 4–43 Income Information for the NTS Region of Influence**

| | *Clark County* | *Nye* | *Nevada* |
|---|---|---|---|
| Median Household Income 1997 ($) | 39,486 | 36,580 | 39,280 |
| Percent of Persons Below Poverty Line (1997) | 11.1 | 12.7 | 10.7 |

Source: DOC 2000.